Clorius Controls A/S

99.46.05-D
GB

ER 3000
Instruction

Contents

⚠ **Warning:**
During electrical equipment operation, the risk that several parts of this unit will be connected to high voltage is inevitable. Improper use can result in serious injuries or material damage. The warning notes included in the following sections of these operating instructions must therefore be observed accordingly. Personnel working with this unit must be properly qualified and familiar with the contents of these operating instructions.
Perfect, reliable operation of this unit presupposes suitable transport including proper storage, installation and operation.

Rights reserved to make technical changes!

1. Function overview

1.1 Brief description

Fluctuations in temperature frequently occur as an unwanted side-effect, on cooling water systems on diesel engines. Such fluctuations are often due to the long dead times of cooling systems, which makes it hard to control the temperature.
The ER 3000 controller is programmed to operate according to the master/slave principle, in this, the slave will intercept any disturbances like to interfere with the overall control. The speed off the slave is considerably faster than the master, this give a fast and precise temperature control.

1.2 Field of application

ER 3000 is a universal microprocessor-based controller prepared for the control of a three-way engine valve in connection with regulation of cooling water systems in diesel engines.
The controller operates as a double-loop controller according to the master/slave principle.

The ER 3000 controller may be adapted to other regulating purposes, if required.

1.3 Functional diagram

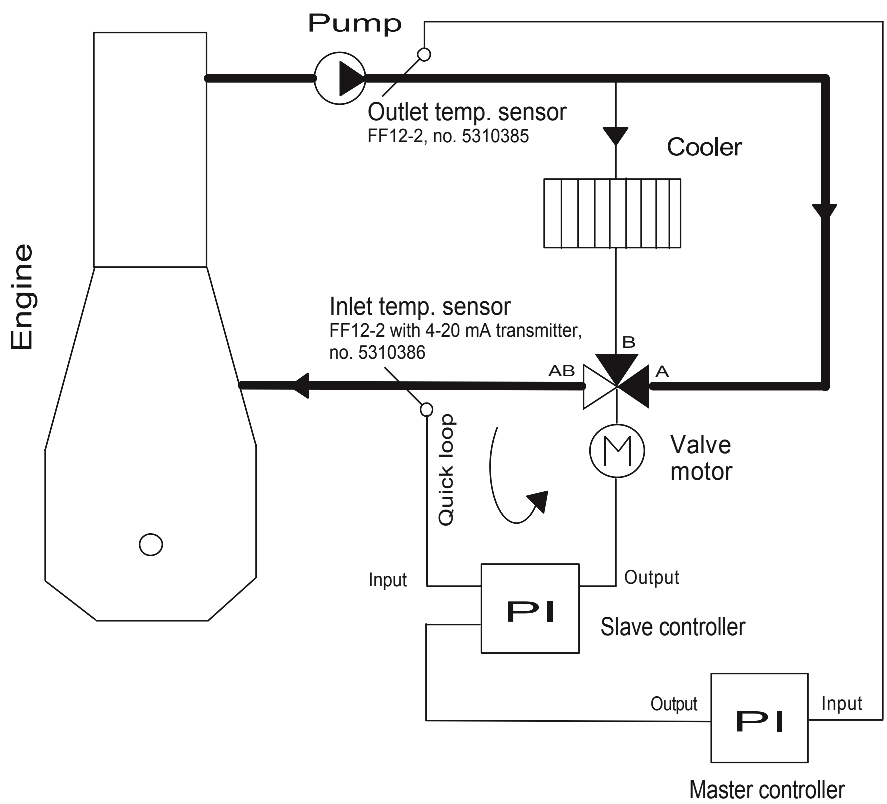
The Clorius ER 3000 controller is programmed to operate according to the master/slave principle. In a master/slave setup the slave will pick up any disturbances likely to interfere with overall control. To make this possible, the slave controller must be considerably faster than the master controller. If the control speed for the slave, is set five to ten times faster than the master, the speed of the slave over that of the master, will enable it to pick up external disturbances as well as to act as a servomechanism, in relation to the master. This will avoid overshooting and irregular control.

The master/slave principle offers the following advantages:

- Fast and precise control procedure.
- Less overshooting.
- Constant and steady control.
- Easy operation.

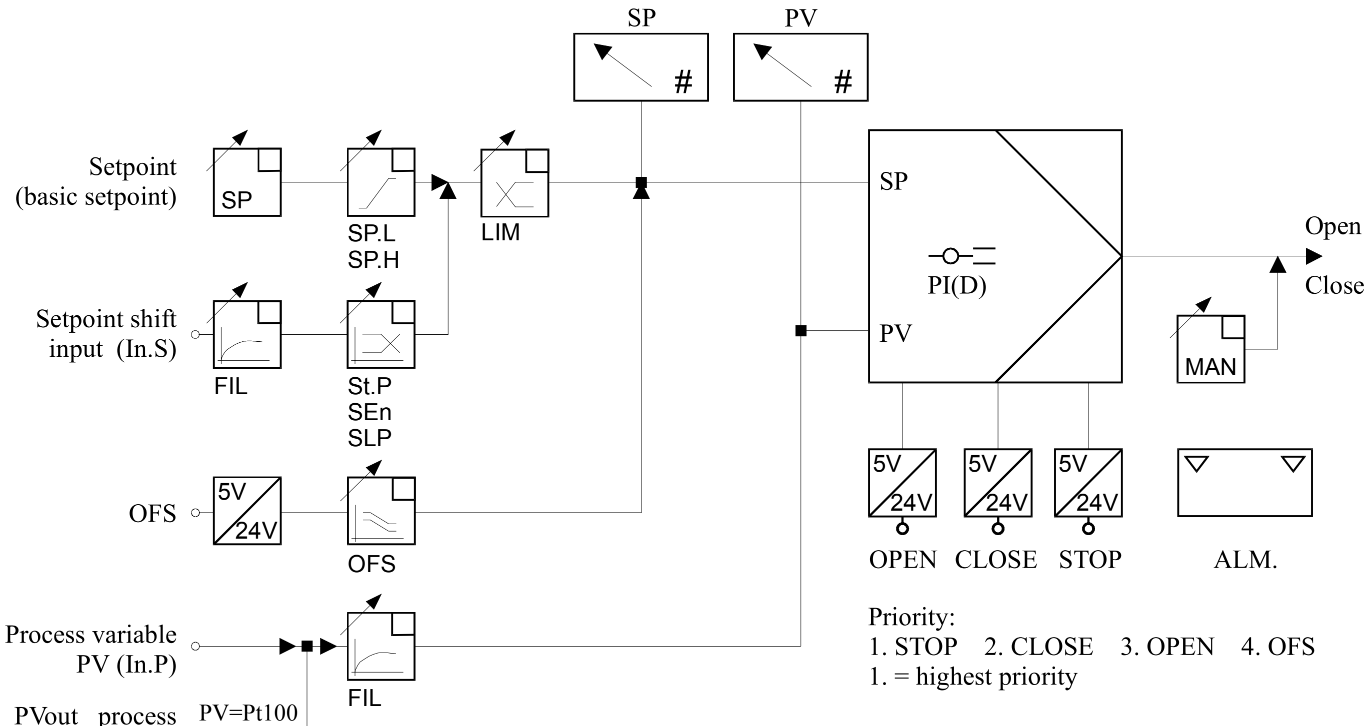
The master is governed by controller #2 and the slave by controller #1.

NB! It is important that the temperature sensor for slave controller #1 is not placed too far away from the control valve. This would slow down the regulation process thus eliminating the servo-effect.

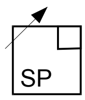


1.4. Sequential circuit

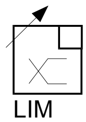
Analogue input Pt100	The analogue inputs can be used optionally as process variable input PV, as setpoint shift input or as input for the slave controlled variable.
Analogue input 0/2 to 10V	
Analogue input 0/4 to 20mA	
Process variable output 0 to + 10 V	For Pt 100 as process variable sensor PV.
Digital input OPEN	Opens the actuator (not in manual mode)
Digital input CLOSE	Closes the actuator (not in manual mode)
Digital input STOP	The actuator stops in its current position (not in manual mode)
Digital input OFS	For setpoint lowering / raising.



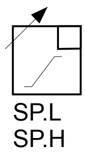
Constant controller with setpoint shift



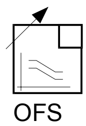
Setpoint entry via keyboard



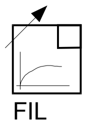
Minimum limitation or maximum limitation of the shifted setpoint



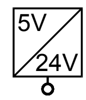
Minimum limitation SP.L and maximum limitation SP.H of the setpoint entry via keyboard



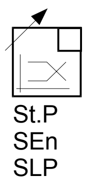
Setpoint raising or setpoint lowering OFS, triggered via digital input OFS



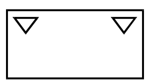
Filter for process variable input PV and setpoint shift input.
Interference signals and fast fluctuations are smoothed



Digital inputs
Voltage range 0 / 12 - 24 VDC
Power supply optionally internal or external

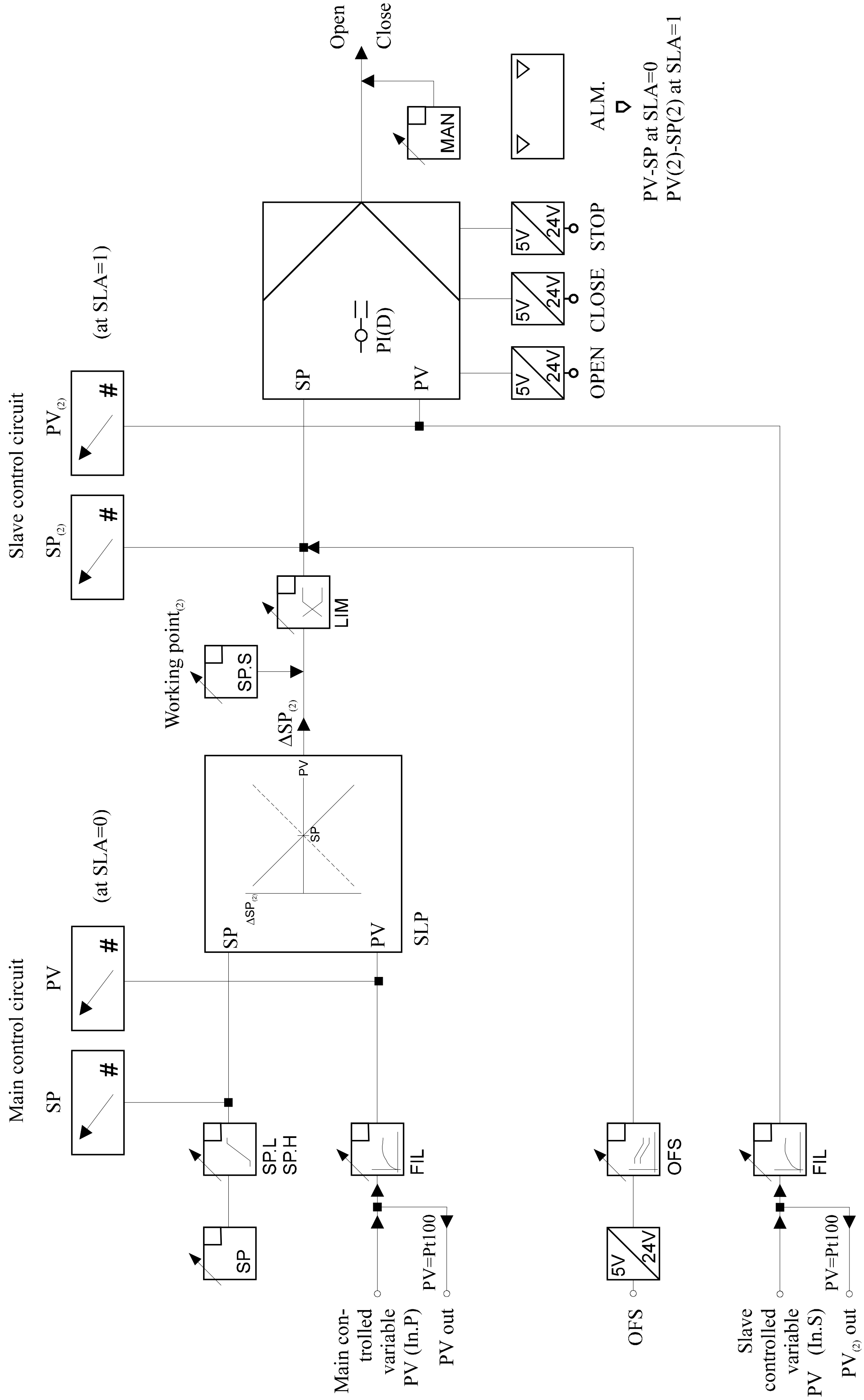


Setpoint shift with starting point St.P, direction of action SEn and influence SLP



ALM.

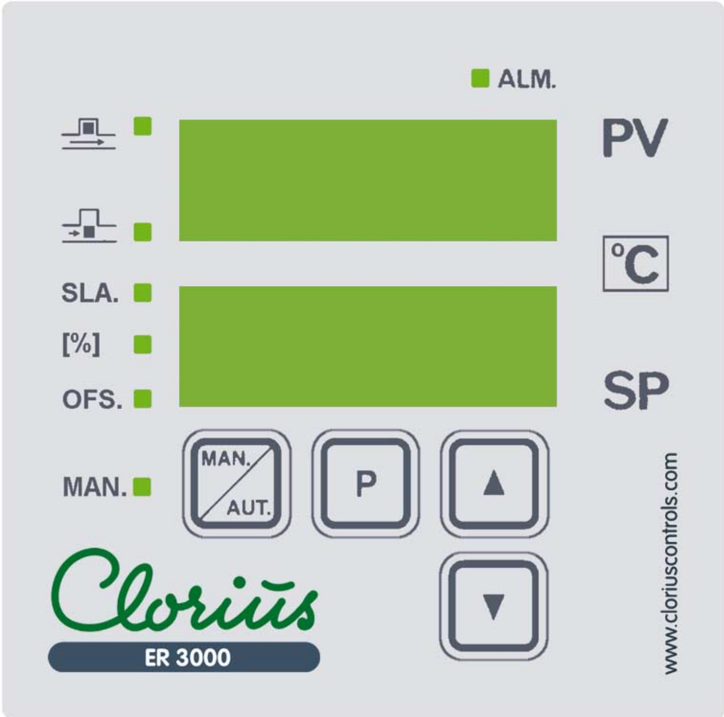
Alarm ∇ ∇ 2 limits possible



Cascade controller

2. Operating and setting

Operating level:



Alarm

Actuator opens

Actuator closes

Slave control circuit is displayed, slave

Display in %

Setpoint raising / lowering effective, offset

Manual mode

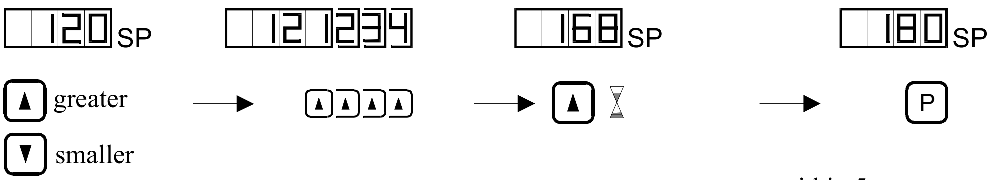
Process variable display

Other phys. units available as sticker

Setpoint display, effective, possibly shifted setpoint

2.1 Setting setpoint SP * in automatic mode

* CAS = 0: Basic setpoint, on which the setpoint shift acts
CAS = 1, SLA = 0: Setpoint of the main controlled variable
CAS = 1, SLA = 1: Basic setpoint of the slave control circuit (working point) which is shifted by the main control circuit



greater

smaller

in individual steps

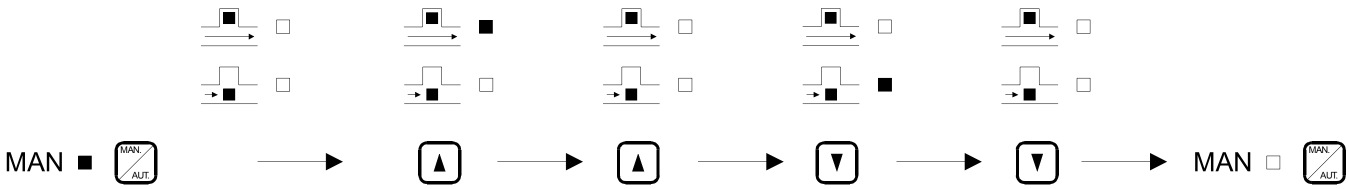
Continuous adjustment at increasing speed

within 5s accept new setpoint, otherwise back to the old, still effective setpoint

= press continuously

CAS = 0: The shifted setpoint is displayed again after pressing the P key.

2.2 Opening / closing actuator in manual mode



Change over to manual mode (lockable)

actuator stops

actuator opens

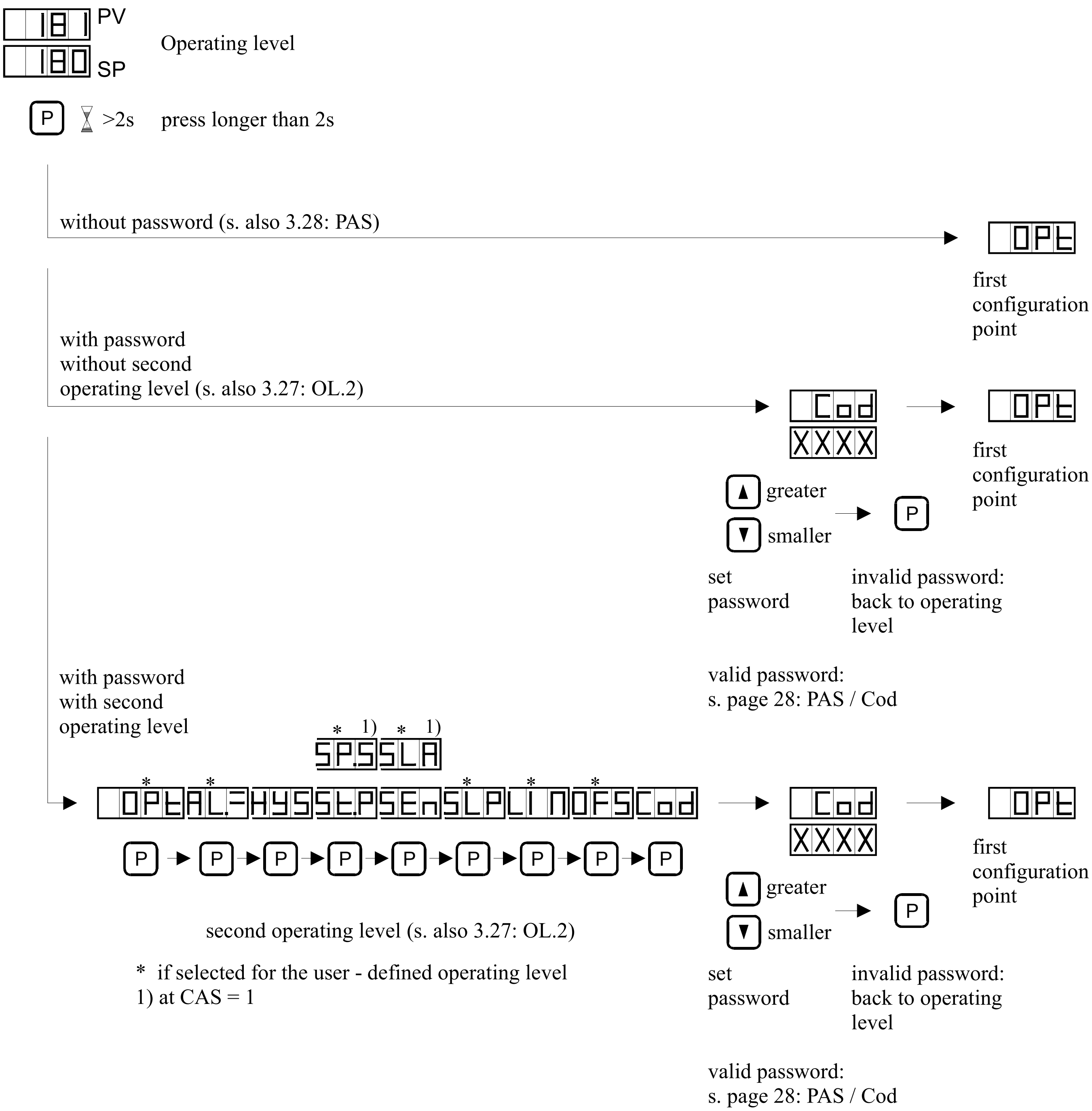
actuator stops

actuator closes

actuator stops

Change over to manual mode (lockable)

2.3 Branch to parameterization -/ configuration level

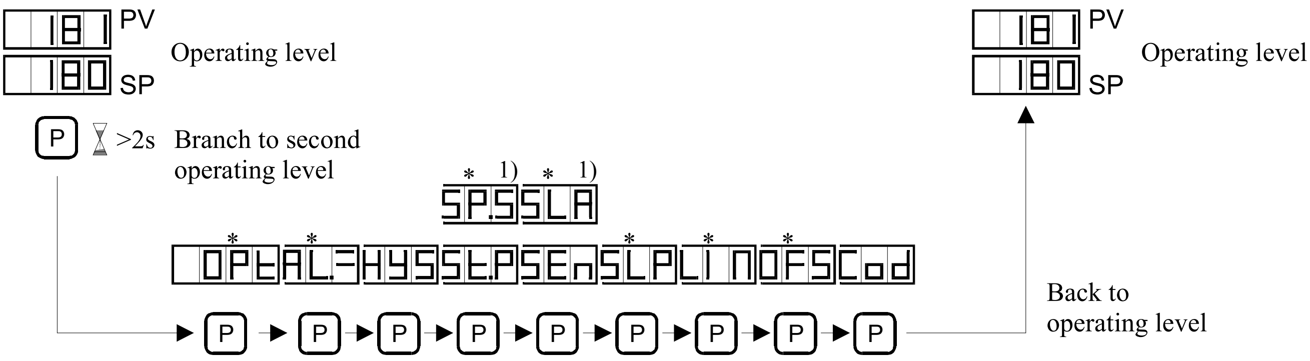


P >2s back to the operating level possible at any time

MAN/AUT. Manual -/ automatic changeover possible at any time

2.4 Branch to second operating level (user - defined operating level)

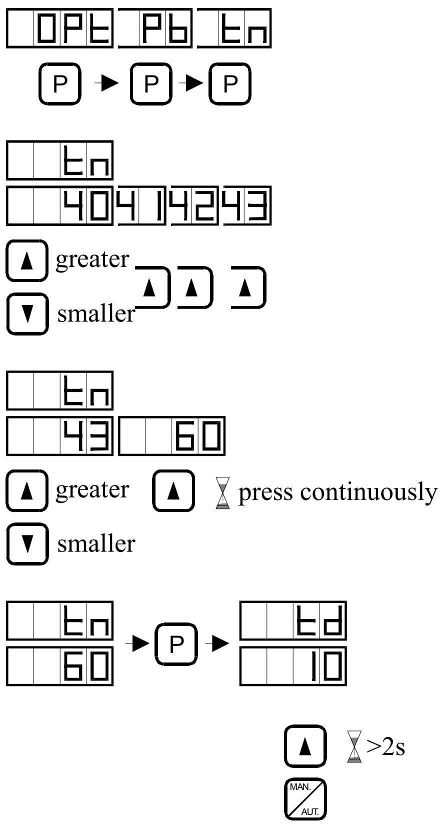
Parameters and configuration points which have been selected for the second operating level (see also 3.27: OL.2) can be called up and set without entering the password, if access to the parameterization -/ configuration level is protected by a password (see also 3.28: PAS).



* if this function was selected for the user - defined operating level and access to the parameterization -/ configuration level was blocked through the password.
[1] at CAS = 1.

At the second operating level, the following can be set optionally
- the self - optimization OPt
- the alarm AL., HYS
- the starting point of the setpoint shift St.P or the basic setpoint of the slave control circuit SP.S
- the effect of the setpoint shift SEn or the display of the slave control circuit SLA
- the influence of the setpoint shift SLP
- the setpoint limitation LIM
- the setpoint raising / lowering OFS.

2.5 Set parameters / configuration points



Select parameter / configuration point

Set new value in individual steps

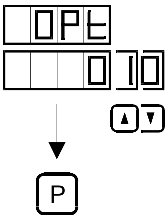
Set new value continuously, at increasing speed

Within 5s accept new value and call up next variable

Back to operating level possible at any time

Manual -/ automatic changeover possible at any time

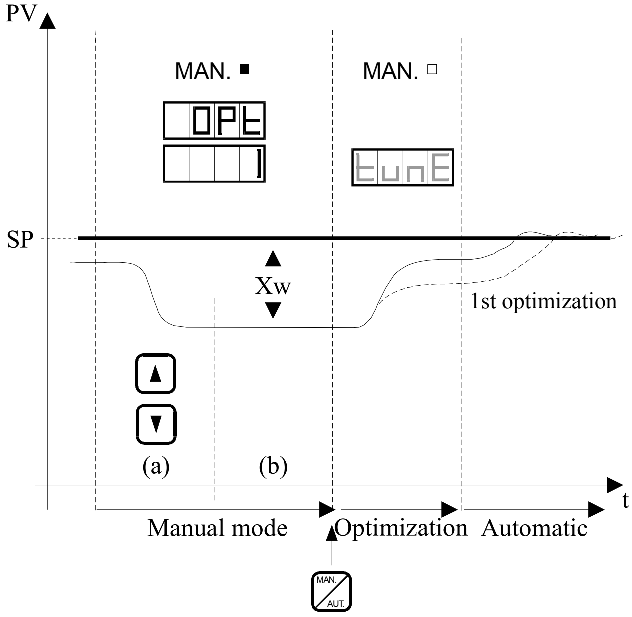
3. Parameterization -/ configuration level



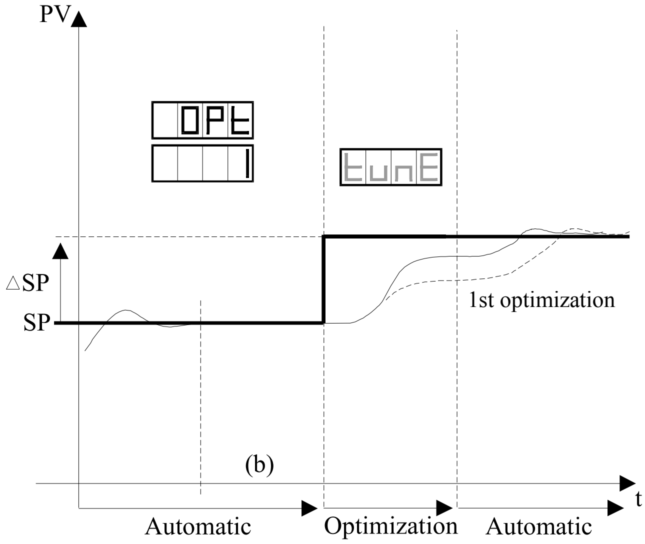
3.1 Optimization for automatic determination of favourable controller parameters

for cascade controller (CAS=1): Optimization of the slave control circuit

Selections: 0 No self - optimization
1 Self - optimization activated



Optimization from manual mode



Optimization in automatic mode

Procedure during optimization:

For the constant controller with setpoint shift (CAS = 0):

From manual mode:

- Set setpoint SP
- Switch over to manual mode
- By opening / closing the actuator, set the process variable PV to a value larger / smaller than the setpoint SP (a)
- Wait until PV has stabilized (b)
- Skip to the parameterization / configuration level
- Set OPt = "1"
- Set SLP = "0" *
- If known, enter process gain P.G (standard setting: P.G = 100%)
- Return to the operating level
- Switch over to automatic mode

In automatic mode:

- Skip to the parameterization -/ configuration level
- Set OPt = "1"
- Set SLP = "0" *
- If known, enter process gain P.G (standard setting P.G = 100%)
- Return to the operating level
- Wait until PV has stabilized (b)
- Set setpoint

* After conclusion of the self - optimization, set SLP back to the wanted value.

For the cascade controller (CAS = 1):

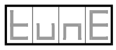
From manual mode:

- Skip to the parameterization -/ configuration level
- Set SLA = "1" (display slave control circuit)
- Set SLP = "0" *
- Return to the operating level
- Set setpoint SP (slave control circuit setpoint)
- Switch over to manual mode
- By opening / closing the actuator, set the process variable PV to a value larger / smaller than the setpoint SP (a)
- Wait until PV has stabilized (b)
- Skip to the parameterization -/ configuration level
- Set OPt = "1"
- If known, enter process gain P.G (standard setting: P.G = 100%)
- Return to the operating level
- Switch over to automatic mode

In automatic mode:

- Skip to the parameterization -/configuration level
- Set SLA = "1" (display slave control circuit)
- Set SLP = "0" *
- If known, enter process gain P.G (standard setting P.G = 100%)
- Set OPt = "1"
- Return to the operating level
- Wait until PV has stabilized (b)
- Set setpoint SP (slave control circuit setpoint)

* After conclusion of the self - optimization set SLP back to the wanted value.



The self - optimization starts with the manual / automatic switchover (for optimization from manual mode) or with the setpoint change ΔSP (for optimization in the automatic mode). The **tunE** display is shown cyclically in the setpoint display SP during the optimization process. The determined parameters (Pb, tn, td, P.G) are taken over automatically at the end of self - optimization.

The optimization routine is not started if the system deviation Xw (manual mode) or the setpoint change ΔSP (automatic mode) is less than 3.125% of the measuring range PV at the start of the optimization process. The change of the process variable PV or of the setpoint SP during the optimization should run in the same range and in the same direction in which the system is controlled after optimization, i.e. the optimization process should correspond as accurately as possible to the later control process. If process sequences with strongly different time behaviour occur in the course of a control sequence (e.g. fast heating up, slow cooling down), then the more important part of the process must be optimized.
If the process sequences are equivalent, then the slower process must be optimized.

In systems with linear transmission behaviour (constant process gain $P.G = \frac{\Delta PV}{\Delta Y}$ over the entire control range), an optimization process already always delivers the optimum controller parameters.
If the transmission behaviour of the system is non - linear (the process gain $P.G = \frac{\Delta PV}{\Delta Y}$ changes, e.g. with the setpoint SP to be controlled), then the variable process gain P.G has a decisive influence on the controller parameters. Here the process variable PV should approximately reach the target setpoint during the optimization process.
If this is not the case, a further optimization process must be performed. The process gain P.G in the working point was determined automatically in the preceding optimization process.
If the process gain P.G in the working point is known, it can be entered manually before starting optimization (see also 3.20: P.G)
The actuator may be neither closed nor 100 % open before the start of or during the optimization process.
The optimization is interrupted automatically, if it is not finished within 42 minutes.
After each performed optimization, the configuration point OPt is set automatically to 0.
An optimization process can be interrupted at any time by pressing the manual - or briefly the **P** key.

NO ENTRIES OR SWITCHING OVER MAY BE PERFORMED DURING THE OPTIMIZATION PROCESS!

Pb

3.2 Proportional band Pb *

Setting range: 1.0 % to 999.9%
Proportional action of the PI(D) three - position step controller

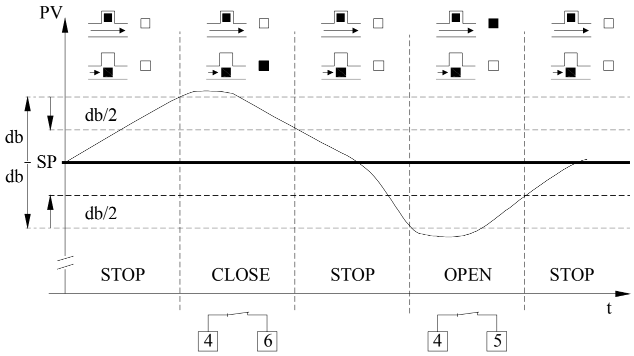
Pb
0.0

3.2.1 Three - position controller *

by settings: **Pb = 0.0**
tn > 0

Control action adjustable via dead band db.

(see also 3.5: db)



3.2.1 Three - position controller

tn

3.3 Integral action time tn *

Setting range: 1s to 2600s
Integral action of the PI(D) three - position step controller

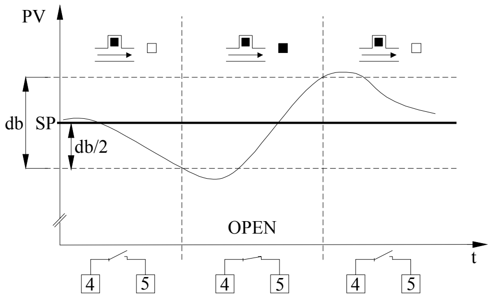
tn
0

3.3.1 Two - position controller

by setting **tn = 0**

Control action adjustable via dead band db.

(see also 3.5: db)



3.3.1 Two - position controller

td

3.4 Derivative action time td *

Setting range: 1 to 255s
Derivative action of the PID three - position step controller
By setting td = 0: PI three - position step controller

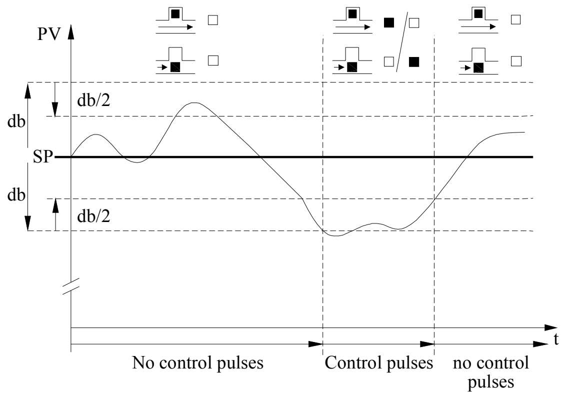
db

3.5 Dead band db *

Setting range: 0 to extent of measuring range [phys. units] (x0,1 at dP = 0)
Hysteresis: db/2

No control pulses at control deviation smaller db.

(see also 3.2.1 three - position controller
3.3.1 two - position controller)



3.5 Dead band

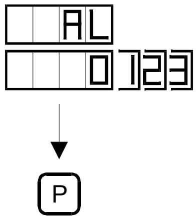
t.P

3.6 Actuating time t.P (Valve actuation time)

Setting range: 5s to 300s
Time to pass through the correcting range 0 to 100 % (stroke) at constant OPEN or CLOSE – pulse

*** at CAS = 1: Parameters of the slave control circuit, slave**

3.7 Alarm

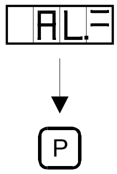


At cascade controller (CAS = 1), the alarm always refers to the displayed control circuit

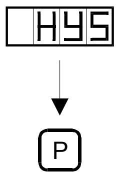
SLA = 0: Main controlled variable PV - setpoint SP of the main controlled variable
SLA = 1: Slave controlled variable PV - setpoint SP of the slave controlled variable

The alarm relay operates according to the closed circuit principle.

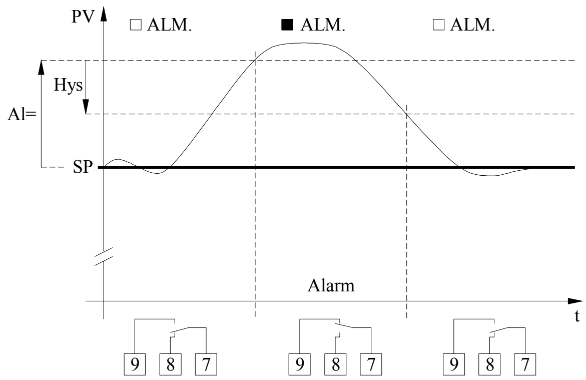
Selection AL = 0:
no alarm, also not on sensor fault
(see also 3.24: SE.b)



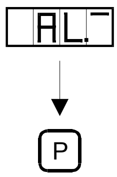
Selection AL = 1:
Alarm at a limit value based on the setpoint SP (type A)
and on sensor fault.
Alarm at SP ± AL =
Setting range: 0 to ± measuring range (physical unit)



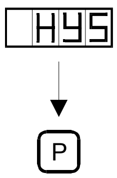
Alarm hysteresis HYS
Release hysteresis of the alarm relay.
Setting range: 0 to measuring range (physical unit) (x 0.1 at dP = 0)



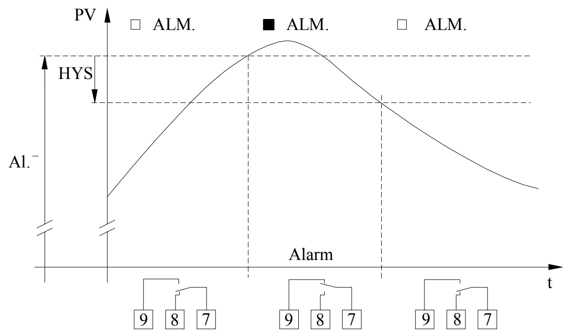
Selection AL = 1 (type A)
In case of sensor failure: Alarm independent of the adjusted limit value



Selection AL = 2:
Alarm at a fixed limit value (type B)
and on sensor fault
Alarm at **AL.¯**
Setting range: Measuring range (physical unit)

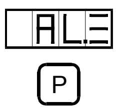


Alarm hysteresis HYS
Release hysteresis of the alarm relay.
Setting range: 0 to measuring range (physical unit) (x 0.1 at dP = 0)

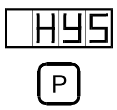


Selection AL = 2 (type B)
In case of sensor failure: Alarm independent of the adjusted limit value

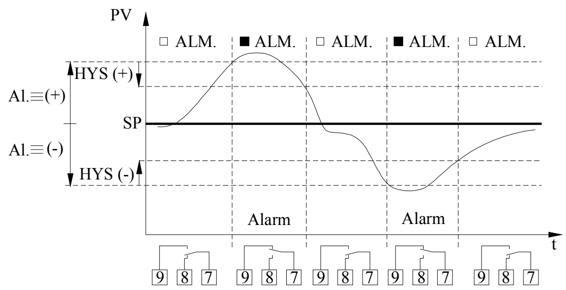
Selection AL = 3:
Alarm at leaving a band around the setpoint SP (type C) and on sensor fault:
Alarm at SP - **AL.≡** and SP + **AL.≡**



Lower band:
Setting range: 0 to - measuring range (physical unit)
Alarm at SP - **AL.≡**



Alarm hysteresis HYS (-)
lower band half, reset hysteresis of alarm relay. Setting range: see before.



Selection AL = 3 (type C)
In case of sensor failure: Alarm independent of the adjusted limit value

Upper band:
Setting range: 0 to + measuring range (physical unit)
Alarm at SP + **AL.≡**

Alarm hysteresis HYS (+)
upper band, release hysteresis of the alarm relay. Setting range see before.

3.8 Decimal point for LED displays

Selections: 0 Display without decimal point
1 Display with decimal point

After each change enter dI.L and dI.H anew (see also 3.9: dI.L, dI.H)

3.9 Scaling the process variable display PV

Display.Low Enter: Zero point of the transmitter
Indication at start of measuring range
Setting range: -999 (-99.9 at dP = 1) ≤ dI.L ≤ dI.H-1 [phys. units] (dI.L must be less than dI.H)
standard value: **0**° C or **32**° F

Display.High Enter: End point of the transmitter
Indication at end of measuring range
Setting range: dI.L+1 ≤ dI.H ≤ 9999 (999.9 at dP = 1) [phys. units] (dI.H must be greater than dI.L)
standard value: **300**° C or **572**° F

At In.P = 0, dI.L and dI.H have to correspond to the Pt 100 - measuring range of the supplied device
(see type plate)
ER 3000 - 2.4 - ... : dI.L = 000(.0), dI.H = 300(.0)
ER 3000 - 2.2 - ... : dI.L = 000(.0), dI.H = 400(.0)
ER 3000 - 2.50 - ... : dI.L = -50(.0), dI.H = 250(.0)
At In.P ¹ 0, dI.L and dI.H have to correspond to the measuring range of the connected transmitter. (s. also 3.21: In.P)
At unt = 1, also valid for the setpoint shift input of the slave control circuit (see also 3.12: unt)

3.10 Setpoint limitation

The setpoint limitation is effective for:
- the basic setpoint for CAS = 0
- the setpoint SP of the main controlled variable for CAS = 1
- the setpoint SP for the slave controlled variable for SLA = 1

It is ineffective for:
- shift signals
- SP.S at CAS = 1

Setpoint.Low lowest settable setpoint
Setting range: dI.L to SP.H (physical unit) (see also 3.9: dI.L)
At SP.L = SP.H, the setpoint is fixed to one value.

Setpoint.High highest settable setpoint
Setting range: SP.L to dI.H (physical unit) (see also 3.9: dI.H)
At SP.L = SP.H, the setpoint is fixed to one value.

3.11 Cascade controller

Selections:

0 Constant controller with setpoint shift through a second analogue input

1 Constant controller, P - PI(D) cascade, slave controlled variable through second analogue input

3.12 Physical unit of the setpoint shift input (at CAS = 0)
Physical unit of the slave control circuit (at CAS = 1)

If - the process variable input PV and the setpoint shift input (at CAS = 0)
- the process variable input PV and the input of the slave controlled variable (at CAS = 1)

have the same physical unit and the same measuring range (e.g. 0 - 300°C), the parameters for the setpoint shift (CAS = 0) or the parameters of the slave control circuit (CAS = 1) can be entered in the range dI.L - dI.H.

Entries in physical unit.

If the process variable input PV and the setpoint shift input (CAS = 0) or the input of the slave controlled variable (CAS = 1) have different physical units or measuring ranges, then the corresponding parameters must be entered in % of the measuring range of the setpoint shift input (CAS = 0) or of the input of the slave controlled variable (CAS = 1).

Selections:

0 Input of the relevant parameters in 0 - 100% of the measuring range of the second analogue input

1 Input of the relevant parameters in the physical unit of the process variable PV, range dI.L - dI.H

Relevant parameters:
- Starting point St.P (at CAS = 0)
- Slave control circuit setpoint SP.S (at CAS = 1)
- Setpoint limitation LIM
- Offset OFS

The LED "(%)" lights up on entries in %.
(see also 3.9: dI.L, dI.H, 3.11: CAS)

3.13 Starting point of the setpoint shift St.P (at CAS = 0)

Setting range: 0 to 100 % of the measuring range of the setpoint shift input (at unt = 0)
LED "(%)"lights up
dI.L to dI.H (physical unit of the process variable PV) (at unt = 1)

Measured value of the setpoint shift input at which the setpoint shift starts.
(see also 3.12: unt, diagram page 15)

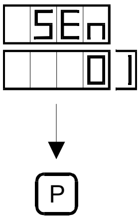
3.14 Setpoint of the slave controlled variable SP.S (at CAS = 1)

Basic setpoint of the slave control circuit
Working point of the cascade controller, setpoint for control deviation = 0

Setting range: 0 to 100 % of the measuring range of the setpoint shift input (at unt = 0)
LED "(%)"lights up
dI.L to dI.H (physical unit of the process variable PV) (at unt = 1)

The setpoint can optionally also be set at the operating level.

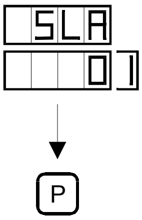
(see also 3.11: CAS, 3.12: unt, diagram page 16)



3.15 Effect of the setpoint shift (at CAS = 0) (sense)

Selections: 0 Setpoint shift for measured values of the setpoint shift input which are smaller than the value of the starting point St.P, shift for measured values < St.P
1 Setpoint shift for measured values of the setpoint shift input which are larger than the value of the starting point St.P, shift for measured values > St.P

Setpoint shift effective for the internal setpoint that can be set on the keyboard
(see also 3.13: St.P, diagram page 15)

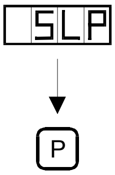


3.16 Display slave control circuit (at CAS = 1) (slave controller)

Selections: 0 Main controlled variable PV and setpoint SP are displayed on the controller, SP can be set. Main control circuit
1 Slave controlled variable and setpoint of the slave controlled variable SP.S (possibly shifted) are displayed on the controller. SP.S can be set. Slave control circuit

LED "SLA" lights up for SLA = 1
LED "(%)" lights up for SLA = 1 and unt = 0

If the slave control circuit is displayed, a possibly set alarm also refers to the slave controlled variable and its setpoint
(see also 3.11: CAS, 3.12: unt, 3.14: SP.S, 3.7: Alarm)



3.17 Influence of SLP (slope)

Influence (strength of the setpoint shift) (for CAS = 0)
Influence of the main control circuit on the slave control circuit (for CAS = 1)

Setting range: (+)1000 to -1000 — 1000 corresponds to factor of 10.00 — (+) is not displayed
-1000 corresponds to factor of 10.00
for setting: SLP = 0: no influence
SLP = 100: influence = 1 : 1 — 100 corresponds to factor of 1.0

for setpoint shift (CAS = 0): SLP positive = only setpoint raising — effect
SLP negative = only setpoint lowering — one - sided

Interplay of St.P, SEn and SLP:

Sen	SLP	St.P
0	positive	Setpoint raising below St.P
0	negative	Setpoint lowering below St.P
1	positive	Setpoint raising above St.P
1	negative	Setpoint lowering above St.P

Influence = delta SP = (difference measured value - St.P) * SLP (one - sided)

SP = setpoint St.P = starting point SEn = effect of the shift SLP = influence

(see also 3.13: St.P, 3.15: SEn, diagram page 17)

for the cascade controller (CAS = 1): Bilateral effect

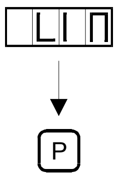
Interplay of PV, SP, SLP and SP.S:

PV, SP	SLP	SP.S
PV larger than SP	positive	SP.S is raised
PV smaller than SP	positive	SP.S is lowered
PV larger than SP	negative	SP.S is raised
PV smaller than SP	negative	SP.S is lowered

Influence = delta SP.S = (SP - PV) * SLP [bilateral]

PV = main controlled variable
SP = setpoint of the main controlled variable
SP.S = setpoint of the slave controlled variable
SLP = influence

(see also 3.14: SP.S, diagram page 24)



3.18 Setpoint limitation LIM

Limitation of the shifted setpoint (for CAS = 0)
Limitation of the setpoint of the slave controlled variable (for CAS = 1)

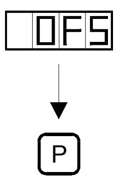
Setting range: -100 % to (+) 100 % of the measuring range of the shift input (at unt = 0)
LED "(%)" lights up (+) is not displayed
- dI.H to (+) dI.H [physical unit of the process variable PV] (at unt = 1)

LIM positive = maximum limitation
LIM negative = minimum limitation

Input: Difference between dI.L and limit

e.g.: dI.L = 0, dI.H = +300:
minimum limit at 60°C: LIM = - (60°C - 0°C) = -60
maximum limit at 90°C: LIM = +(90°C - 0°C) = +90
e.g.: dI.L = -50°C, dI.H = +250:
minimum limit at 60°C: LIM = - (60°C + 50°C) = -110
maximum limit at 90°C: LIM = +(90°C + 50°C) = +140

The setpoint limitation LIM is ineffective for the offset OFS.
(see also 3.12: unt, 3.19: OFS, diagram page 17)



3.19 Setpoint offset OFS

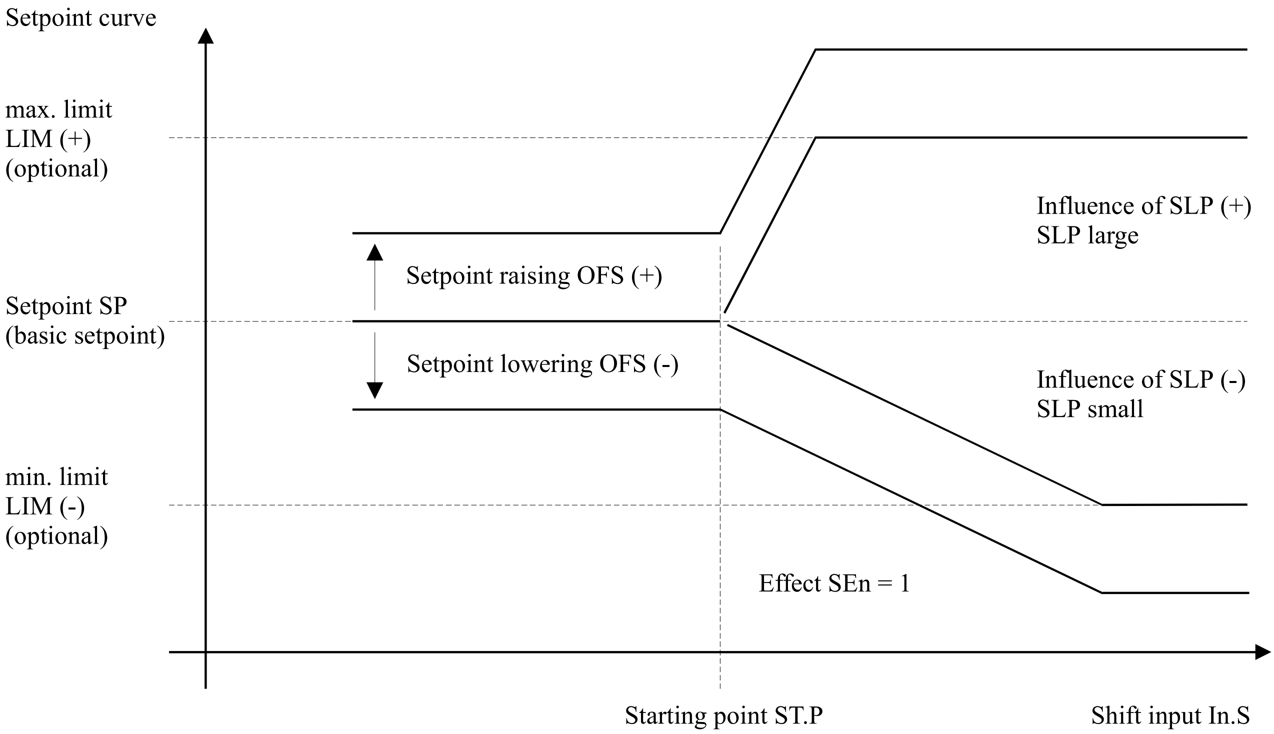
Lowering / raising the shifted setpoint (for CAS = 0)
Lowering / raising the setpoint of the slave controlled variable (for CAS = 1)

Setting range: -100 % to (+) 100 % of the measuring range of the shift input (at unt = 0)
LED "(%)" lights up (+) is not displayed
- dI.H to (+) dI.H [physical unit of the process variable PV] (at unt = 1)

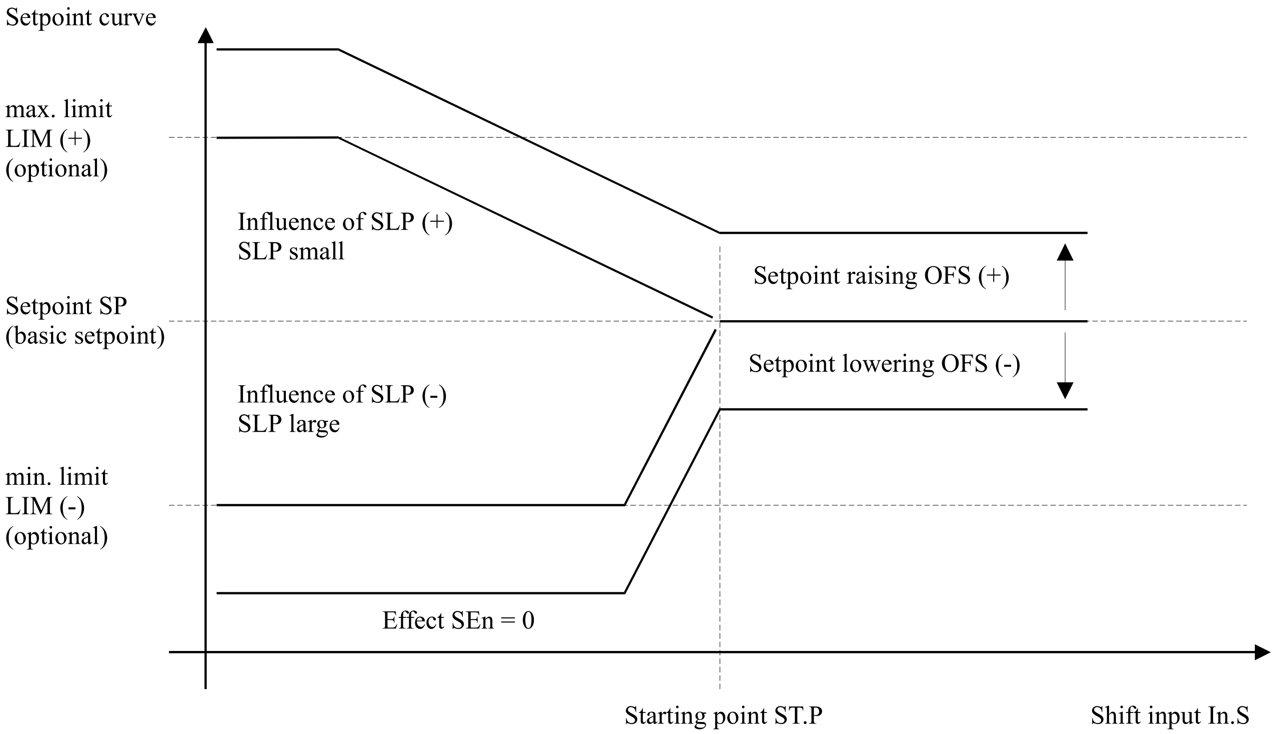
OFS positive = setpoint raising by the absolute amount of OFS
OFS negative = setpoint lowering by the absolute amount of OFS (e.g. night lowering)
OFS = 0 = no raising / lowering

The setpoint lowering / raising is triggered through the digital output OFS.
LED "OFS" lights up on setpoint raising / lowering
The setpoint limitation LIM is ineffective for OFS.
(see also 3.11: CAS, 3.12: unt, 3.18: LIM, diagram page 17, 5.1: Connection diagram)

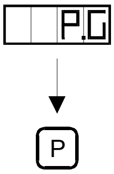
Setpoint shift through the analogue input In.S



Setpoint shift for values of the shift input In.S larger than ST.P



Setpoint shift for values of the shift input In.S smaller than ST.P



3.20 Process gain P.G

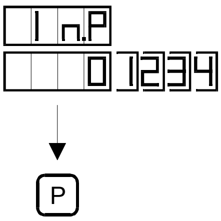
Setting range: 1 to 255 %

Gain of the controlled system $P.G = \frac{\text{Change of the process variable PV}}{\text{Change of the process variable Y}} = \frac{\Delta PV}{\Delta Y}$ in %

ΔPV [% of the measuring range of PV]
ΔY [% of the actuating range (stroke) 0 - 100 %]

e.g.: P.G = 50%: $\frac{\Delta PV}{\Delta Y} = 0{,}5$	A change of the valve position ΔY of 10% results in a change in the process variable PV of 5%.
P.G = 100%: $\frac{\Delta PV}{\Delta Y} = 1{,}0$	A change of the valve position ΔY of 10% results in a change in the process variable PV of 10%.
P.G = 125%: $\frac{\Delta PV}{\Delta Y} = 1{,}25$	A change of the valve position ΔY of 10% results in a change in the process variable PV of 12.5%.

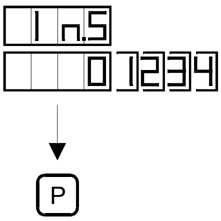
The process gain P.G is required for the self - optimization of the control parameters. If it is unknown, P.G is determined automatically during self - optimization. (see also 3.1: OPt)
On non - linear transfer behaviour of the system, the process gain changes with the working point (e.g. on controlling different setpoints).



3.21 Input for process variable PV (at CAS = 0) (input PV)
Input for main controlled variable PV (at CAS = 1)

Selections:
- 0 PV is supplied with a Pt100 sensor and connected to terminals 14, 15, 16
- 1 PV is supplied as 0-20 mA current signal and connected to the terminals 12, 16*
- 2 PV is supplied as 4-20 mA current signal and connected to the terminals 12, 16*
- 3 PV is supplied as 0-10 V voltage signal and connected to the terminals 13,16
- 4 PV is supplied as 2-10 V voltage signal and connected to the terminals 13,16

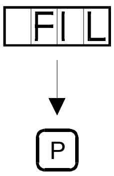
* not for connection of a transducer in two - wire system
(see also 5: Electrical connection)



3.22 Input for setpoint shift signal (at CAS = 0) (input SP)
Input for slave controlled variable PV (at CAS = 1)

Selections:
- 0 Pt100 sensor, terminals 14, 15, 16
- 1 0-20 mA current signal, terminals 12, 16 *
- 2 4-20 mA current signal, terminals 12, 16 *
- 3 0-10 V voltage signal, terminals 13,16
- 4 2-10 V voltage signal, terminals 13,16

(see also 5: Electrical connection)



3.23 Measured value filter for analogue inputs (filter)

Software 1st order low - pass filter with adjustable time constant Tf for suppressing interference signals and for smoothing fast measured value fluctuations.
Setting range: 100 to 255

Formula :
Tf = -0,04/ln(input/256)

The following assignment applies:

Input:	255	254	252	250	240	230*	220	200
Tf [s]:	10,22	5,10	2,54	1,69	0,62	0,37	0,26	0,16

* Standard setting

SE.b
012

P

3.24 Response to PV sensor failure

Reaction of the actuator in automatic mode on: Sensor short circuit, sensor break, current / voltage signal too high or too low at 4-20 mA and 2-10 V

Selections: 0 Actuator closes
1 Actuator opens
2 Actuator stays in its momentary position

In a transmitter / sensor fault, the error message Err (error) appears in the LED display PV. Alarm message if alarm A, B or C is configured, independent of the set alarm limit.

Err PV

After the fault is no longer present, the controller returns automatically to the automatic mode. In the case of electrical signals without live zero point, 0-20 mA or 0-10 V, no monitoring for line break and short circuit is possible.

MAn
01
P

3.25 Interlocking the manual / automatic switchover (manual)

Selections: 0 Switching over by keyboard possible at any time
1 Interlocking in the momentary conditions
MAn. to -1- in automatic mode: constant automatic mode
MAn. to -1- in manual mode: constant manual mode

dir
01
P

3.26 Direction of action of the controller

Selections: 0 Heating controller: with rising controlled variable PV, the actuator closes
1 Cooling controller: with rising controlled variable PV, the actuator opens

OL.2

P

3.27 Second operating level (operating level 2)

Select functions of the user - defined operating level.

Setting range: 0 to 127:

0 No second operating level
1 Self - optimization can be activated at the 2nd operating level (see also 3.1: OPt)
2 Limit and hysteresis of the selected alarm can be entered at the 2nd operating level (see also 3.7: Alarms)
4 The starting point of the setpoint shift St.P for CAS = 0 or the setpoint of the slave controlled variable SP.S for CAS = 1 can be set at the 2nd operating level (see also 3.13: St.P, 3.14: SP.S)
8 The effect of the setpoint shift SEn for CAS = 0 or the display of the slave control circuit SLA for CAS = 1 can be set at the 2nd operating level (see also 3.15: Sen, 3.16: SLA)
16 The influence SLP can be set at the 2nd operating level (see also 3.17: SLP)
32 The setpoint limitation LIM can be set at the 2nd operating level (see also 3.18: LIM)
64 The setpoint offset OFS can be set at the 2nd operating level (see also 3.19: OFS)

The code numbers of the wanted functions are added and the result is entered.
The password must be activated (see also 3.28: PAS)
Access to the user - defined operating level is not protected by the password.

PAS
01

P

3.28 Access to the parameterization / configuration level (password)

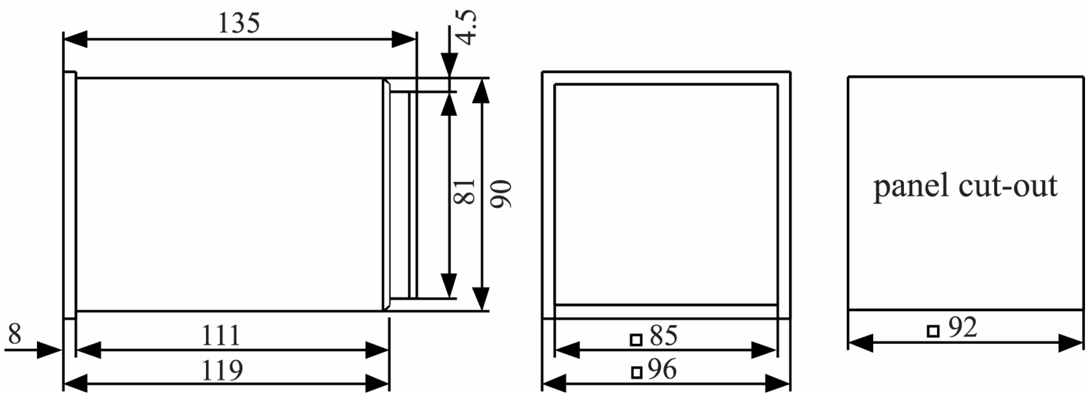
Protecting the parameterization / configuration level through the password **Cod** prevents unauthorized access.

Selections: 0 No protection of the parameterization / configuration level. OL.2 ineffective.
1 Access to the parameterization / configuration level only after entry of the password on the keyboard. OL.2 effective
(see also 3.27: OL.2; valid password: page 29: PAS / Cod)

4. Installation

The device is suitable for front panel installation and for installation in consoles with arbitrary installation position. Push the controller from the front into the control panel cut-out provided for it and fasten by means of the enclosed clamps.

⚠ The ambient temperature at the installation point must not exceed the permissible temperature for the nominal use. Ensure sufficient ventilation, also for larger packing density of the devices. The device must not be installed inside explosion - hazardous areas.

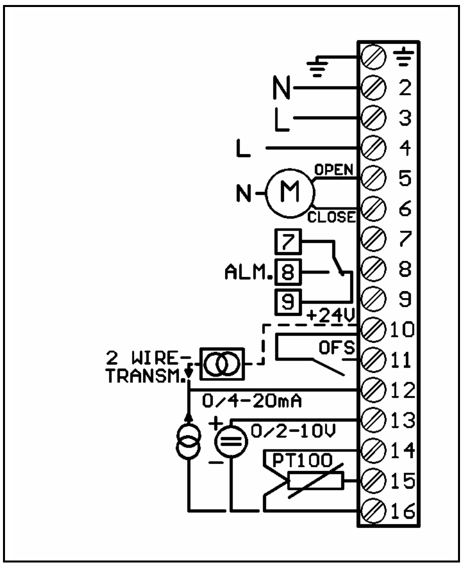


Housing dimensions

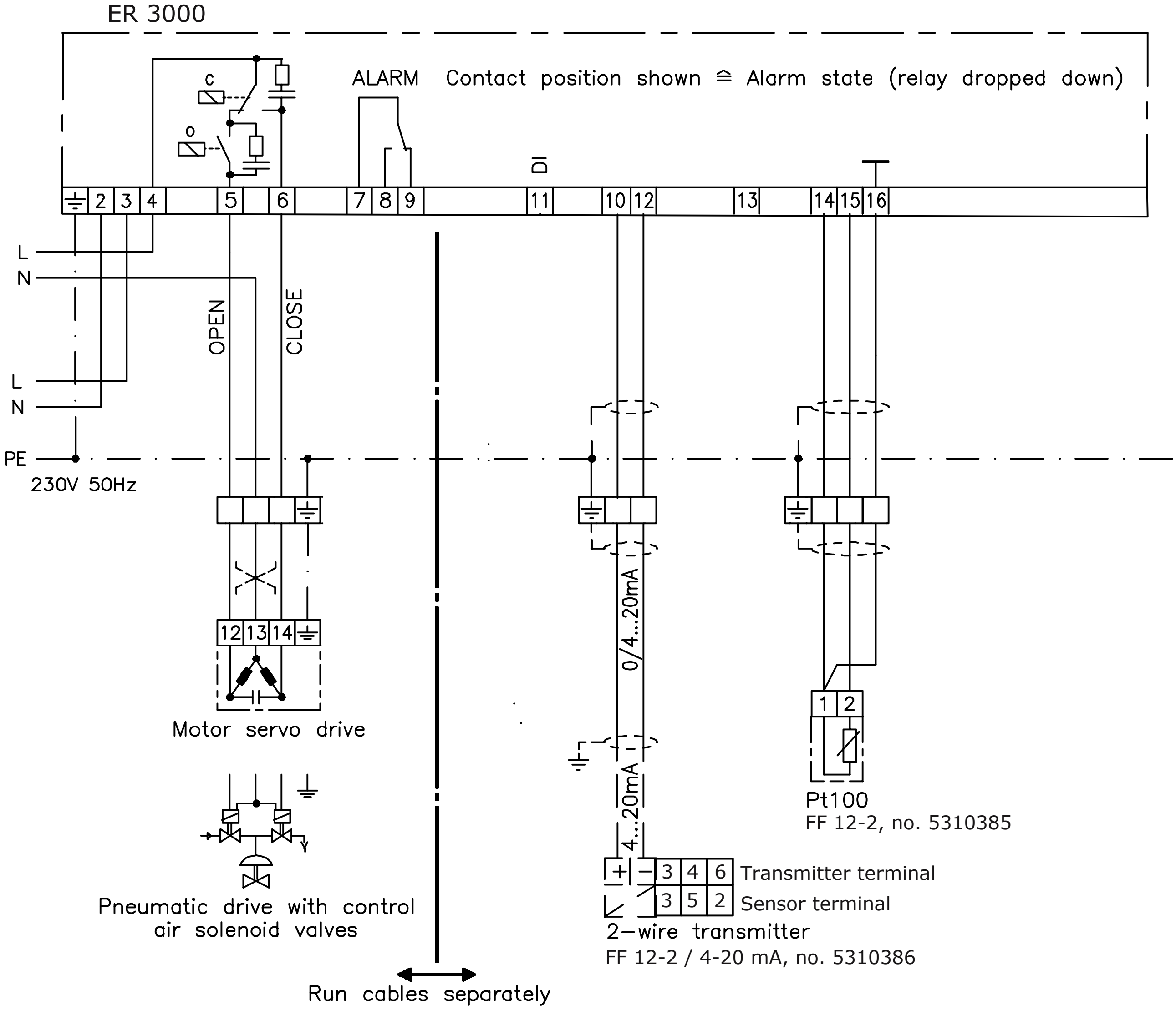
5. Electrical connection

The plug - type connection terminals and the connection diagram are located at the rear of the device.

⚠ The relevant valid national regulations (e.g. in Germany DIN VDE 0100) must be observed for the installation. The electrical connection is made according to the connection diagrams / connection pictures of the device. Shielded cables must be used for measuring leads and control leads (digital inputs). These must also be run in the control cabinet separately from power current leads.
Before switching on ensure that the system voltage stated on the name plate agrees with the line voltage.
The connection terminals may be pulled off from the device only in the currentless state with connected cables.



5.1 Connection diagram



6. Commissioning

6.1. Commissioning the constant controller with setpoint shift input (CAS = 0)

Sequence:	Remedial action in the case of faults:
☐ Device installed correctly ?	see also 4: Installation
☐ Electrical connection according to valid regulations and connection diagrams ?	see also 5: Electrical connection
☐ Switch on line voltage. When the device is switched on, all display elements on the front panel light up for approx. 2 s (lamp test). The device is then ready for use.	Compare system voltage on the name plate with line voltage.
☐ Switching over to manual mode	see also 2.2: Manual mode
• Does the process variable display PV correspond to the process variable at the measuring site ?	Check sensor, measuring cable and electrical connection. see also 5: Electrical connection, 3.21: In.P, 3.9: dI.L, dI.H
• Does the process variable display PV fluctuate / jump	Adjust measuring filter FIL. See also 3.23: FIL Is the device in the direct vicinity of strong electrical or magnetic interference fields ?
• Switch in digital inputs *	see also 5: Electrical connection
- Do the corresponding LED on the front panel light up ?	Check power supply for digital inputs, external switching contacts, signal cables and electrical connection. see also 5.1: Connection diagram
• Is the setpoint shifted correctly ?	see also 3.11: CAS, 3.12: unt, 3.13: St.P, 3.17: SLP, 3.18: LIM, 3.19: OFS
• Does the setpoint display SP fluctuate / jump	Adjust measuring filter FIL, see also 3.23: FIL Reduce influence SLP, see also 3.17: SLP
• Open actuator - Heating controller: does process variable PV rise ? - Cooling controller: does process variable PV fall ? • Close actuator - Heating controller: does process variable PV fall ? - Cooling controller: does process variable PV rise ?	see also 2.2: Manual mode no reaction: Check actuator and electrical connection between controller and actuator Reversed reaction: Change over OPEN and CLOSE actuator control see also 5.1: Connection diagram
• Enter actuating time t.P of the connected actuator	see also 3.6: t.P
• Set controller parameters with the aid of self - optimization	see also 3.1: OPt
• Set strength of the setpoint shift	see also 3.17: SLP
☐ Automatic mode	
Manual / Automatic switchover	see also 2.2: Manual mode
Set setpoint SP	see also 2.1: Set setpoint SP in automatic mode
☐ Control pulses of the controller too short, switching frequency too high	Enlarge the dead band db see also 3.5: db

* Option

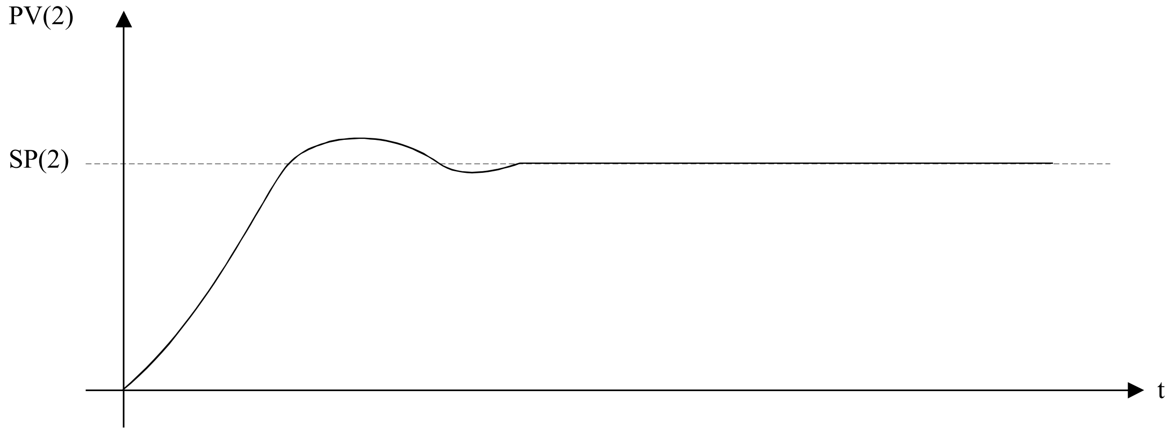
6.2. Commissioning the cascade controller (CAS = 1)

Sequence:	Remedial action in the case of faults:
☐ Device installed correctly ?	see also 4: Installation
☐ Electrical connection according to valid regulations and connection diagrams ?	see also 5: Electrical connection
☐ Switch on line voltage. When the device is switched on, all display elements on the front panel light up for approx. 2 s (lamp test). The device is then ready for use.	Compare system voltage on the name plate with line voltage.
☐ Switching over to manual mode	see also 2.2: Manual mode
• Does the process variable display PV of the main controlled variable and of the slave controlled variable correspond to the value at the measuring site ?	Check sensor, measuring cable and electrical connection. see also 5.: Electrical connection, 3.9: dI.L, dI.H, 3.12: unt, 3.16: SLA, 3.21: In.P, 3.22: In.S
• Does the process variable display PV fluctuate / jump	Adjust measuring filter FIL. See also 3.23: FIL Is the device in the direct vicinity of strong electrical or magnetic interference fields ?
• Switch in digital inputs *	see also 5.: Electrical connection
- Do the corresponding LED on the front panel light up ?	Check power supply for digital inputs, external switching contacts, signal cables and electrical connection. see also 5.1: Connection diagram
• Open actuator - Heating controller: does process variable PV rise ? - Cooling controller: does process variable PV fall ? • Close actuator - Heating controller: does process variable PV fall ? - Cooling controller: does process variable PV rise ?	see also 2.2: Manual mode no reaction: Check actuator and electrical connection between controller and actuator Reversed reaction: Change over OPEN and CLOSE actuator control see also 5.1: Connection diagram
• Enter actuating time t.P of the connected actuator	see also 3.6: t.P
• Set controller parameters with the aid of self - optimization	see also 3.1: OPt, 3.16: SLA Set SLA = 1
☐ Automatic mode	
• Manual / Automatic switchover	see also 2.2: Manual mode
• Display main control circuit	Set SLA = 0, see also 3.16: SLA
• Set influence SLP - Control tends to oscillations - Control quiet, but large process variable - setpoint difference	 Reduce SLP, see also 3.17: SLP Increase SLP, see also 3.17: SLP
• Set working point SP.S - Process variable PV > setpoint SP - Process variable PV < setpoint SP	 Reduce SP.S Increase SP.S
• Set setpoint SP	see also 2.1: Set setpoint SP in automatic mode
☐ Control pulses of the controller too short, switching frequency too high	Enlarge the dead band db see also 3.5: db

* Option

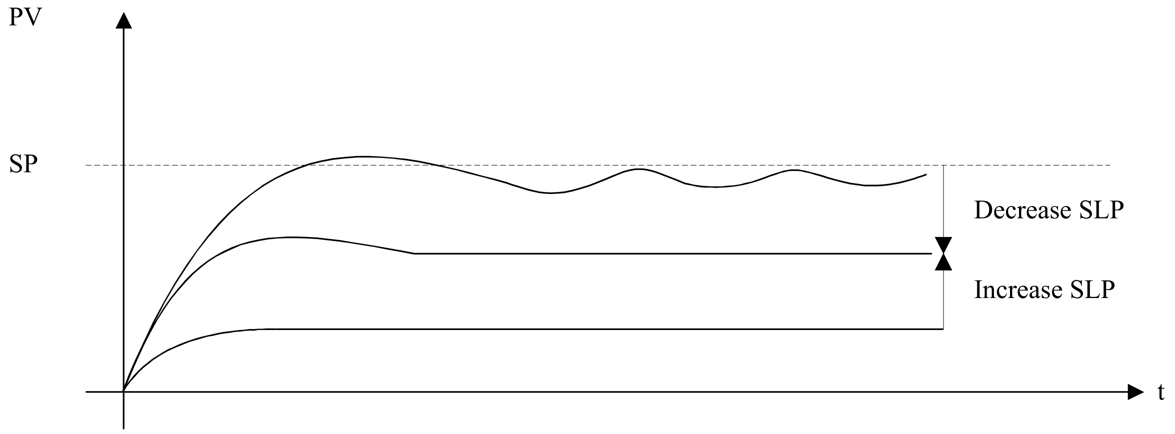
Commissioning the cascade controller

1) Slave control circuit (SLA = 1)



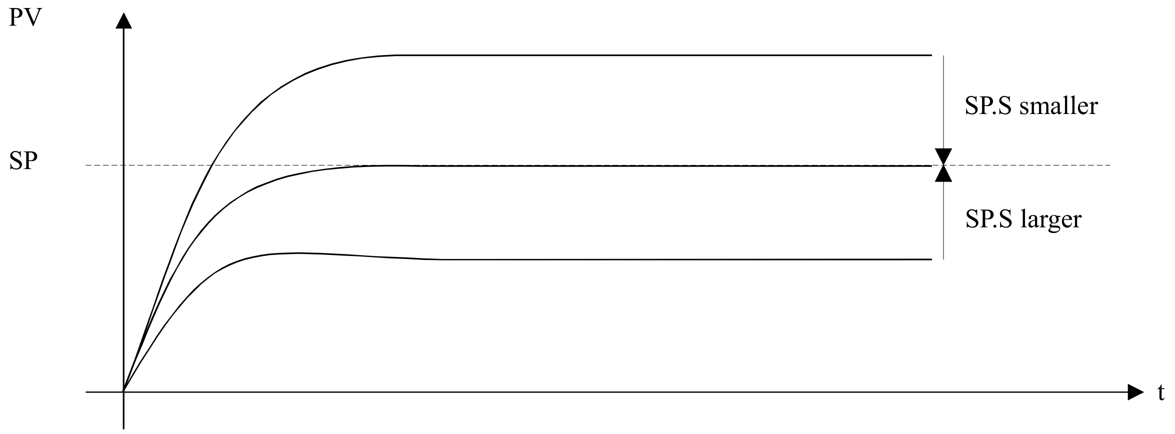
Adjust slave control circuit with the aid of the self - optimization

2) Main control circuit (SLA = 0)



Adjust influence of SLP

3) Main control circuit (SLA = 0)



Adjust basic setpoint SP.S (working point).

7. Technical data

Line voltage	230 V AC 115 V AC 24 V AC } -15% / +10%, 50/60 Hz
Power consumption	approx. 7 VA
Weight	approx. 1 kg
Permissible ambient temperature	
- Operation	0 to 50ºC
- Transport and storage	-25º to + 65ºC
Degree of protection	Front IP 65 according to DIN 40050
Design	For control panel installation 96 x 96 x 135 mm
Installation position	arbitrary
DI - feed voltage and measuring transducer feed voltage	24 V DC, Imax. = 60 mA
Analogue inputs	Pt100, 2.4 = 0°C to 300°C or 2.2 = 0°C to 400°C or 2.50 = -50°C to 250°C Connection in three - wire system 0/4 to 20 mA, input resistance = 50 Ohm 0/2 to 10 V, input resistance = 100 KOhm
Measuring accuracy	0.1% of the measuring range
Digital inputs	high active, Ri = 1 k W; n.c. / 0V DC = low 15 V to 24 V DC = high
Analogue output for process variable	0 to +10 V corresponds with 0° to 300°C (2.4) or 0° to 400°C (2.2) or -50°C to 250 °C (2,50), Imax. = 2 mA
Displays	Two 4 - digit 7 segment displays, LED ,red, character height = 13 mm
Alarms	Alarm type A, B, C; working contact closed circuit principle
Relay	Switching capacity: 250 V AC / 3 A Spark quenching element
Data protection	Semi - conductor memory

8. Order number ER 3000

ER 3000 / 1 - 2.4 - 230 V - 00.0
2.2 115 V
2.50 24 V

Device versions

Pt100 0°C to 300°C (2.4)
Pt100 0°C to 400°C (2.2)
Pt100 -50°C to 250°C (2.50)

Line voltage 230 V AC
115 V AC
24 V AC

00.0 Standard type

Device versions	ER 3000
1 x Pt 100 input	X
1 x 0 / 4 to 20 mA input	X
1 x 0 / 2 to 10 V input	X
Supply voltage 24 V DC	X
1 x Digital input OFS	X

9. Overview of parameterization / configuration level, data list

Parameter / configuration point	Display	Setting		Remarks	
Self - optimization	OPt	0 1		no self - optimization activate as required	CAS = 1: optimization of the slave control circuits, slave
Proportional band	Pb			1.0 to 999.9 %	CAS = 1: Pb - slave control circuit
Three position controller	Pb =	0	☐	tn > 0; db corresponds to dead band	
Integral action time	tn			1 to 2600 s	CAS = 1: tn - slave control circuit
Two - position controller	tn =	0	☐	db corresponds to dead band	
Derivative action time td	td			1 to 255 s; PI control for td = 0	CAS = 1: td - slave control circuit
Dead band	db			0 to measuring range [physical unit] (x 0.1 for dP = 0)	CAS = 1: db - slave control circuit
Actuating time	t.P			5 to 300 s	
Alarm	AL	0 1 2 3	☐ ☐ ☐ ☐	No alarm, also not on sensor fault Alarm A, depending upon setpoint Alarm B, fixed limit Alarm C, band around the setpoint	and for sensor fault, independent of limit CAS = 1, SLA = 0 main control circuit alarm
Alarm A	AL.=			0 to ± measuring range [physical unit] for AL = 1	
Release hysteresis	HYS			0 to measuring range (x0.1 for dP=0)	
Alarm B	AL.-			Measuring range: dI.L to dI.H [physical unit] for AL = 2	CAS = 1, SLA = 1
Release hysteresis	HYS			0 to measuring range (x0.1 for dP=0)	Alarm slave control circuit
Alarm C low	AL.≡			0 to - measuring range [physical unit] for AL = 3	
Release hys. low	HYS			0 to measuring range (x0.1 for dP=0)	
Alarm C high	AL.≡			0 to + measuring range [physical unit] for AL = 3	
Release hys. high	HYS			0 to measuring range (x0.1 for dP=0)	
Decimal point	dP	0 1	☐ ☐	Display without decimal point Display with decimal point	
Scaling low	dI.L			Display value for measuring range -999 to dI.H-1 [phys. unit]	
Scaling high	dI.H			Display value for measuring range end dI.L+1 to 9999 [phys. unit]	
Setpoint limitation low	SP.L			dI.L to SP.H [phys. unit]	CAS = 0: valid for keyboard setpoint
Setpoint limitation high	SP.H			SP.L to dI.H [phys. unit]	CAS = 1: valid for main control circuit
Cascade controller	CAS	0 1	☐ ☐	Constant controller with setpoint shift Cascade controller	
Physical unit	unt	0 1	☐ ☐	0 to 100 % dI.L to dI.H [phys. unit]	CAS = 0: of the shift input CAS = 1: of the slave control circuit
Starting point (at CAS = 0)	St.P			0 to 100 % [phys. unit] at unt = 0 dI.L to dI.H [phys. unit] at unt = 1	
Slave control circuit setpoint (at CAS = 1)	SP.S			0 to 100 % [phys. unit] at unt = 0 dI.L to dI.H [phys. unit] at unt = 1	

Parameter / configuration point	Display	Setting		Remarks	
Effect of the setpoint shift (at CAS = 0)	SEn	0	☐	Shift below St.P	
		1	☐	Shift above St.P	
Slave control circuit (at CAS = 1)	SLA	0	☐	Display main control circuit; PV, SP	
		1	☐	Display slave control circuit; $PV_{(2)}$, $SP_{(2)}$	
Influence	SLP	[ ]		-1000 to + 1000 100 = factor 1.0 0: no influence	CAS = 0: Influence of the shift signal CAS = 1: Influence of the main control circuit on the slave control circuit
Setpoint limitation	LIM	[ ]		- 100 % to +100 % at unt = 0 - dI.H to + dI.H [phys. unit] at unt = 1	
Setpoint offset	OFS	[ ]		- 100 % to +100 % at unt = 0 - dI.H to + dI.H [phys. unit] at unt = 1	- = setpoint lowering + = setpoint raising Triggered through digital input OFS
Process gain	P.G	[ ]		1 to 255 %, for self - optimization	
Process variable input PV	In.P	0	☐	Pt 100	CAS = 1: for main controlled variables
		1	☐	0 to 20 mA	
		2	☐	4 to 20 mA	
		3	☐	0 to 10 V	
		4	☐	2 to 10 V	
Shift input Input for slave controlled variable	In.S	0	☐	Pt 100	CAS = 0: Setpoint shift input CAS = 1: Input for slave controlled variable
		1	☐	0 to 20 mA	
		2	☐	4 to 20 mA	
		3	☐	0 to 10 V	
		4	☐	2 to 10 V	
Measured value filter PV	FIL	[ ]		100 to 255 corresponds 42 ms to 10 s	
Sensor break PV	SE.b	0	☐	Actuator closes	in automatic mode
		1	☐	Actuator opens	
		2	☐	Actuator stays in its positions	
Manual / automatic switchover	MAn	0	☐	Switching over by keyboard	
		1	☐	Locking in momentary state automatic	
			☐	Locking in momentary state manual	
Direction of action of the controller	dIr	0	☐	Heating controller	CAS = 1: of the slave control circuit
		1	☐	Cooling controller	
Second operating level	OL.2	0	☐	No second operating level	
		1	☐	Self - optimization	Add code numbers of the selected functions and set PAS to 1
		2	☐	Alarm and hysteresis	
		4	☐	Starting point of the setpoint shift St.P (CAS = 0) or setpoint of the slave controlled variable SP.S (CAS = 1)	
		8	☐	Setpoint shift Sen (CAS = 0) or the display of the slave control circuit SLA (CAS = 1)	
		16	☐	Influence of SLP	
		32	☐	Setpoint limitation LIM	
		64	☐	Setpoint offset OFS	
		[ ]		Code number	

Parameter / configuration point	Display	Setting		Remarks
Password	PAS	0	☐	No interlock, OL.2 ineffective
		1	☐	Access only after entry of the valid password, OL.2 effective, functions on OL.2 not interlocked
		1500		Code

Device number	
Date	
Tested	
System	

Notes:

10. Suggestion for initial parameterization / configuration level, data list for jacket water cooling applications

Parameter / configuration point	Display	Suggested setting		Actual setting	Setting range	
Self - optimization	OPt	0	☒		no self - optimization	CAS = 1: optimization of the slave
		1			activate as required	control circuits, slave
Proportional band	Pb	50			1.0 to 999.9 %	CAS = 1: Pb - slave control circuit
Three position controller	Pb =	0	☐		tn > 0; db corresponds to dead band	
Integral action time	tn	300			1 to 2600 s	CAS = 1: tn - slave control circuit
Two - position controller	tn =	1,2	☐		db corresponds to dead band	
Derivative action time td	td	0			1 to 255 s; PI control for td = 0	CAS = 1: td - slave control circuit
Dead band	db	0,1			0 to measuring range [physical unit] (x 0.1 for dP = 0)	CAS = 1: db - slave control circuit
Actuating time	t.P	60			5 to 300 s	
Alarm	AL	0	☐		No alarm, also not on sensor fault	CAS = 1, SLA = 0
		1	☒		Alarm A, depending upon setpoint	and for sensor main control
		2	☐		Alarm B, fixed limit	fault, independent circuit alarm
		3	☐		Alarm C, band around the setpoint	of limit
Alarm A	AL.=	10			0 to ± measuring range [physical unit] for AL = 1	
Release hysteresis	HYS	1,0			0 to measuring range (x0.1 for dP=0)	
Alarm B	AL.-				Measuring range: dI.L to dI.H [physical unit] for AL = 2	CAS = 1,
						SLA = 1
Release hysteresis	HYS				0 to measuring range (x0.1 for dP=0)	Alarm slave
Alarm C low	AL.≡				0 to - measuring range [physical unit] for AL = 3	control circuit
Release hys. low	HYS				0 to measuring range (x0.1 for dP=0)	
Alarm C high	AL.≡				0 to + measuring range [physical unit] for AL = 3	
Release hys. high	HYS				0 to measuring range (x0.1 for dP=0)	
Decimal point	dP	0	☒		Display without decimal point	
		1	☐		Display with decimal point	
Scaling low	dI.L	60			Display value for measuring range -999 to dI.H-1 [phys. unit]	
Scaling high	dI.H	85			Display value for measuring range end dI.L+1 to 9999 [phys. unit]	
Setpoint limitation low	SP.L	0			dI.L to SP.H [phys. unit]	CAS = 0: valid for keyboard setpoint
Setpoint limitation high	SP.H	300			SP.L to dI.H [phys. unit]	CAS = 1: valid for main control circuit
Cascade controller	CAS	0	☒		Constant controller with setpoint shift	
		1	☐		Cascade controller	
Physical unit	unt	0	☒		0 to 100 %	CAS = 0: of the shift input
		1	☐		dI.L to dI.H [phys. unit]	CAS = 1: of the slave control circuit
Starting point (at CAS = 0)	St.P	0,0			0 to 100 % [phys. unit] at unt = 0 dI.L to dI.H [phys. unit] at unt = 1	
Slave control circuit setpoint (at CAS = 1)	SP.S				0 to 100 % [phys. unit] at unt = 0 dI.L to dI.H [phys. unit] at unt = 1	

Parameter / configuration point	Display	Factory setting		Actual setting	Setting range	
Effect of the setpoint shift (at CAS = 0)	SEn	0	☒		Shift below St.P	
		1	☐		Shift above St.P	
Slave control circuit (at CAS = 1)	SLA	0	☒		Display main control circuit; PV, SP	
		1	☐		Display slave control circuit; $PV_{(2)}$, $SP_{(2)}$	
Influence	SLP				-1000 to + 1000 100 = factor 1.0 0: no influence	CAS = 0: Influence of the shift signal CAS = 1: Influence of the main control circuit on the slave control circuit
Setpoint limitation	LIM	100,0			- 100 % to +100 % at unt = 0 - dI.H to + dI.H [phys. unit] at unt = 1	
Setpoint offset	OFS	0,0			- 100 % to +100 % at unt = 0 - dI.H to + dI.H [phys. unit] at unt = 1	- = setpoint lowering + = setpoint raising Triggered through digital input OFS
Process gain	P.G	2,5			1 to 255 %, for self - optimization	
Process variable input PV	In.P	0	☒		Pt 100	CAS = 1: for main controlled variables
		1	☐		0 to 20 mA	
		2	☐		4 to 20 mA	
		3	☐		0 to 10 V	
		4	☐		2 to 10 V	
Shift input Input for slave controlled variable	In.S	0	☐		Pt 100	CAS = 0: Setpoint shift input CAS = 1: Input for slave controlled variable
		1	☐		0 to 20 mA	
		2	☒		4 to 20 mA	
		3	☐		0 to 10 V	
		4	☐		2 to 10 V	
Measured value filter PV	FIL	200			100 to 255 corresponds 42 ms to 10 s	
Sensor break PV	SE.b	0	☒		Actuator closes	in automatic mode
		1	☐		Actuator opens	
		2	☐		Actuator stays in its positions	
Manual / automatic switchover	MAn	0	☒		Switching over by keyboard	
		1	☐		Locking in momentary state automatic	
			☐		Locking in momentary state manual	
Direction of action of the controller	dIr	0	☒		Heating controller	CAS = 1: of the slave control circuit
		1	☐		Cooling controller	
Second operating level	OL.2	0	☒		No second operating level	
		1	☐		Self - optimization	Add code numbers of the selected functions and set PAS to 1
		2	☐		Alarm and hysteresis	
		4	☐		Starting point of the setpoint shift St.P (CAS = 0) or setpoint of the slave controlled variable SP.S (CAS = 1)	
		8	☐		Setpoint shift Sen (CAS = 0) or the display of the slave control circuit SLA (CAS = 1)	
		16	☐		Influence of SLP	
		32	☐		Setpoint limitation LIM	
		64	☐		Setpoint offset OFS	
					Code number	
Password	PAS	0	☐		No interlock, OL.2 ineffective	
		1	☐		Access only after entry of the valid password, OL.2 effective, functions on OL.2 not interlocked	
		1500			Code	

Device number	
Date	
Tested	
System	

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